'98 Annual Report

European Space Agency
Agence spatiale européenne

THE ACTIVITIES

B

Scientific Projects
Scientific Research & Earth Sciences
Earth Observation
Telecommunications
Space Transportation
Manned Spaceflight & Microgravity
Technical & Operational Support
Technology
International Cooperation
Public Relations
Publications

Space Transportation

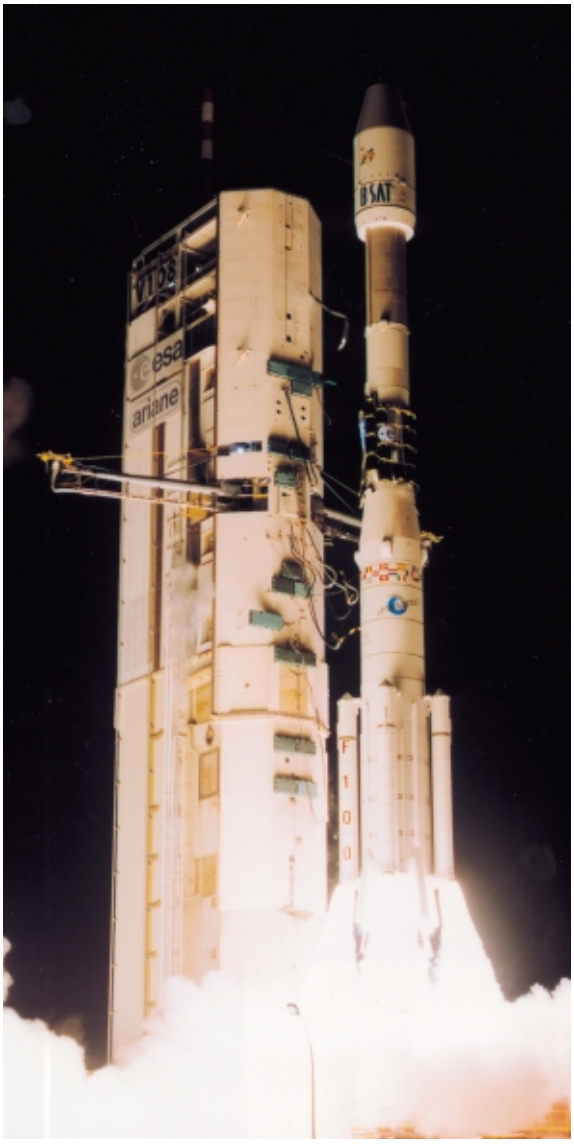
Ariane-4 Operational Launches

The 11 Ariane launches successfully carried out in 1998 put a total of 14 spacecraft into orbit. During the year, Ariane compiled an impressive log of record-breaking achievements. In October, three flights were completed in a single month, namely Ariane-4 flights 111 and 113 and Ariane-5 flight 503. When Ariane-4 flight 113 lifted-off on 28 October it set a new performance record; the Ariane 44L vehicle used, with four liquid-propellant boosters, injected a total payload mass of 4947 kg into Geostationary Transfer Orbit (GTO). With flight 115 just a few weeks later, Ariane-4 achieved its 42nd consecutive successful launch, chalking up a success rate of 96.43%.

Ariane-5 Qualification

On 21 October, Europe reconfirmed its lead in providing space-transportation systems for the 21st Century when Ariane-5, on its third qualification flight, dispelled any doubts as to its ability to deliver payloads reliably and accurately to GTO. Ariane-503 was the final qualification flight carried out under ESA's responsibility prior to the launcher entering commercial service with Arianespace.

This third Ariane-5 test flight was intended primarily to qualify Europe's new launcher for satellite injection



The 108th Ariane launch on 29 April. The Ariane-44P vehicle, with four solid-propellant strap-on boosters, delivered the Japanese Bsat-1B and Egyptian Nilesat-101 spacecraft to Geostationary Transfer Orbit (GTO)

Launches in 1998

Flight Number	Launch Date	Version	Passengers	Orbit	Payload kg
V105	04.02.98	44LP	Brasilsat-B3 & Inmarsat-3F5	GTO	4261.3
V106	27.02.98	42P	Hotbird-4	GTO	2966.6
V107	24.03.98	40	Spot-4	SSO	2799.7
V108	28.04.98	44P	Nilesat-101 & Bsat-1B	GTO	3533.2
V109	25.08.98	44P	ST1	GTO	3316.8
V110	16.09.98	44LP	PAS-7	GTO	3880.9
V111	05.01.98	44L	Eutelsat-W2 & Sirius-3	GTO	4817.7
V112	21.10.98	A503	ARD & Maqsat-3	Sub orbit + GTO	5711
V113	28.10.98	44L	Afristar & GE-5	GTO	4946.9
V114	06.12.98	42L	Satmex-5	GTO	4216
V115	22.12.98	42L	PAS-6B	GTO	3666.6

Lift-off of Ariane-503 from Europe's spaceport in Kourou, French Guiana, on 21 October, on the new launcher's third qualification flight

into GTO, but it also carried the Atmospheric Re-entry Demonstrator (ARD) capsule. ARD was packed with the most advanced equipment to test and qualify new European technologies and flight-control capabilities for atmospheric re-entry and landing. With the highly successful release, re-entry and subsequent recovery of the automatic ARD capsule (built for ESA by Aerospatiale), Europe also moved a step closer to flying its own complete space missions. Engineers analysing real-time telemetry data from its sub-orbital flight reported that all of the capsule's systems performed well and according to expectations.

Ariane-5 Evolution

The Ariane-5 Evolution Programme was given the go-ahead at the Ministerial Conference in Toulouse in 1995, with the aim of ensuring the launcher's steady adaptation to evolving market requirements by increasing its overall dual payload lift capability from 5970 to 7400 kg in GTO. The main improvements proposed under the Programme are:

- modifications to the Vulcain engine to increase its thrust from 1145 to 1350 kN
- reduction of the dry mass of the two solid-booster stages by using improved technology to join cylindrical sections (welding instead of the present seals and bolted junctions)
- simplification and lightening of the dual-launch system (Sylda-5), to achieve a 350 kg mass reduction compared with the current Speltra.

Major progress was made in 1998 in the development of Vulcain-2, with delivery of all subsystems by the end of the year. Assembly of the first engine was started in December. The Sylda-5 payload-carrying structure was qualified and will be flown on the first commercial Ariane-5 flight (A504). The weldability of the booster segments was also successfully demonstrated.

The first flight of Ariane-5 Evolution has been brought forward to April 2002, in order to cope with the continuous growth in satellite masses and the associated market requirements.

ARTA Complementary Programme

The Ariane-5 Research and Technology Accompaniment (ARTA-5) Programme was involved in two test campaigns with the Vulcain engine and one for Aestus, the EPS storable propellant stage engine. One booster from the Ariane-503 launch was recovered for post-flight analysis. Sampling tests were performed with components from the storable upper stage and from the attitude control system to verify their compliance with the qualified configuration.

Recovery of the Ariane-503 booster

Members of the Ariane Programme Board during their visit to the Guiana Space Centre in November

Qualification of a new solid propellant for the boosters and separation motors of Ariane-4 was pursued under the ARTA-4 programme. A test campaign with the Vulcain engine was completed, and a test campaign for the HM7-B is in preparation.

ELA-3 and Associated Ariane-5 Facilities

Launch-facility modifications linked to the increased Ariane-5 production rate and the launching of the upgraded versions of the vehicle were studied during the year. A start was made with the extension of the Booster Integration Building (BIP) as well as with the building of a new Booster Storage Building (BSP) and Booster Preparation Building (BPE). The development of a second launch table for Ariane-5, to be ready in 1999, also progressed significantly in 1998.

Most of the Ariane-5 facilities, including ELA-3, have now been formally handed-over by ESA to Arianespace or to industry in Europe and in French Guiana.

Guiana Space Centre

The Guiana Space Centre provided support services for the 11 Ariane launches in 1998: 10 Ariane-4s and one Ariane-5. These activities, managed by CNES on behalf of ESA with European contractors, include co-ordination of overall launch-range operations, ground and in-flight safety, tracking and telemetry stations, meteorology, telecommunications, operations and maintenance for payload-preparation and logistical facilities.

As part of the range investment programme, the following facilities were considered for upgrading:

- the Ariane-4 telemetry equipment of the down-range stations network
- a new meteorological radar
- a new mobile telemetry receiving station.

Ariane-5 Plus Programmes

The Resolution adopted by the ESA Council Meeting held in Brussels in June to start the first step of the Ariane-5 Plus Programme gave the means to prepare for the longer-term decisions that will have to be taken at the next Ministerial Conference, in May 1999. Following on from the decision taken in 1995

in Toulouse to initiate the Ariane-5 Evolution Programme, the Member States opted for a competitive European heavy-lift vehicle that is both more powerful and more flexible.

The Ariane-5 Plus Programme is composed of two parts:

- Ariane-5V, corresponding to an adaptation of the present upper section, to make the European launcher compatible with missions involving long ballistic phases and multiple ignitions of the storable-propellant stage, to be available in 2002. The lower composite will be that of Ariane-5 Evolution.
- Ariane-5C, involving the development of a cryogenic, re-ignitable upper stage. In an interim phase, by 2002, use will be made of the current Ariane-4 HM7-B engine, which is not re-ignitable (known for this version as the ESC-A stage). A new, higher-performance cryogenic engine that is re-ignitable and more economical (to be known as the ESC-B stage) will be readied by the end 2005. This will then be made operational alongside the storable-propellant version, suited for Low Earth Orbit (LEO) missions.

The industrial team has been selected for the definition of the main elements of Ariane-5C. A system concept review held at the end of 1998 confirmed the architecture chosen for the ESC-A stage.

Vega Small Launcher Development Programme

In recent years there has been considerable growth in the number of smaller, standardised satellite platforms being proposed and developed in Europe. At the same time, substantial pre-design work on small-launcher configurations has been carried out, primarily in Italy and France, in the last few years which provides a good basis for a European small-launcher development programme. It was also realised that the development and operation of such a launcher for Europe could take advantage of technologies, facilities and hardware developed within the Ariane Programme and other national programmes.

It was against this background that, at its 23/24 June meeting, the ESA Council approved the first phase of the Vega Small Launcher Development Programme. The minimum capability for the new small launcher has been preliminarily set at:

- 700 kg of payload in a circular, 1200 km altitude, 100 deg inclination orbit, or
- 1000 kg of payload in a circular, 100 km altitude, polar orbit for a launch from Kourou, by the year 2002.

The Vega design consists of three solid-propulsion stages, with an additional liquid- propulsion upper module that provides roll control and pitch, yaw and axial thrusting during the final phase of flight. The

Test firing of Vega's Zefiro second-stage motor by FiatAvio, on 18 June

first stage is based on a solid-rocket motor derived from the Ariane-5 solid booster (P230), with a reduced propellant mass. The second stage is based on the Zefiro 16t solid-propellant motor, developed by FiatAvio under contract to the Italian Space Agency. The motor's low-mass carbon-epoxy case, loaded with solid propellant, was successfully test fired on 18 June. The third stage is based a 7 t solid-rocket motor, presently called P7, which will take advantage of the Zefiro development effort and previous French developments for a motor of similar size.

A preliminary evaluation of Vega's compatibility with the Kourou launch facilities has identified both ELA-1 and ELA-3 as potentially suitable launch sites, and the various trade-offs are currently being reviewed.

Future European Launchers and FESTIP

The Future European Space Transportation Investigations Programme (FESTIP) is intended to provide Europe with cheaper access to space beyond Ariane-5. To this end, it seeks to define reusable launcher configurations adapted to Europe's requirements (system work), to develop the necessary technologies to acquire practical experience with reuse operations, and to validate those technology developments under realistic flight conditions (in-flight experimentation work).

The FESTIP system work revolved around an integrated system concept team who designed possible launcher configurations to identical requirements and with common design tools. The work planned for 1997–1998, which built upon that conducted during the first slice of FESTIP covering the years 1994–1996, was fully completed and presented at a Workshop held in September.

The concepts retained for further analysis include semi-reusable and reusable vehicles promising a significant launch-cost reduction. One of the most promising configurations is the reusable sub-orbital single stage, which ejects the payload, equipped with an upper stage, at orbital altitude but less than orbital velocity. Another option relies on a reusable first stage that initially carries an expendable second stage derived from Ariane-5, but which might evolve into a fully reusable configuration.

The work reported here will serve as an input to the ESA Future Launchers Technologies Programme, to be reviewed at the next Council Meeting at Ministerial Level, in 1999.

FESTIP two stage-to-orbit, fully reusable rocket launcher. The first and second stages have identical exterior shapes, but different propulsion and interior arrangements. The first stage flies back to the launch site after stage separation at around 2 km/s velocity. The second stage reaches a stable orbit into which the payload is ejected